

thus: "Truth is a constant variable; add a fact and change the outlook, and you have a new truth." In other words, truth is constantly changing—and one must change with change.

I should like to emphasize that this plan is a feasible solution of the problem—a practical program which can be carried out by anyone who aspires to attain advanced knowledge of the best in the medical arts. Your practice will not suffer—per contra, your community will have increased confidence in you, and a feeling of greater security. To raise our average, it is not inconceivable that in the very near future, examinations qualifying us to practice our arts will be required every few years. All would then see the need for the program of continuous education. It is in this way that we will forge ahead from present imperfect to future perfect.

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ANESTHESIA FOR MILITARY NEEDS*

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ANESTHESIA with Medical Service of the Division.—In order to appreciate the anesthesia problems which confront the surgeon charged with responsibility of the medical service of the Division, a brief review of the organization is indicated. It must be understood that the primary function of the medical service in the forward echelons of a fighting force are those of first aid and evacuation of casualties to the rear where definitive treatment may be given. The first aid emergency treatment which is received by casualties in the combat zone is highly important, and may be the factor determining the difference between life and death.

We are primarily concerned with the organization of the Triangular Division, since that has become the nucleus of our streamlined fighting forces. The Triangular Division is so designated because of the position of the assault regiments, namely two regiments abreast and one in reserve. This Triangular Division is served by a Medical Battalion, which consists of _____ officers and _____ enlisted men. This Medical Battalion has been streamlined in comparison with the Medical Regiment to almost one-half the strength of the Medical Regiment, which consists of _____ officers, _____ warrant officers and _____ enlisted men. In a similar manner, the Triangular Division has been derived from the old Square Division, so named because it consisted of two regiments abreast and two in reserve, and which had a strength of approxi-

mately _____ as compared with the Triangular Division's strength of about _____.

Regimental Medical Detachment.—In addition to the Division being served by the Medical Battalion, a unit known as Regimental Medical Detachment is attached. This unit makes up the forwardmost portion of the medical service of the Division. It is entirely separate from the Medical Battalion and is attached directly to the regiment as an integral part of the combat force. This Detachment consists of _____ officers and _____ enlisted men. Briefly, the Regimental Medical Detachment's function is to render first aid to casualties on the battlefield and evacuate them to the Battalion Aid Station, located three hundred to eight hundred yards in the rear, depending upon the type of action in progress. It supplies two company or Battery Aid Men to each company or battery of infantry or field artillery. These men stay with that particular company or battery at all times, and render first aid to the casualties on the battlefield. They also direct the walking wounded toward the Battalion Aid Station. Litter-bearers, who are also supplied from this detachment evacuate the casualties to the Battalion Aid Station. The function of the Regimental Medical Detachment ends at the Battalion Aid Station from which point the Medical Battalion takes up the responsibility of evacuating the casualties to the rear.

The Medical Battalion is divided into three collecting companies, each of which services a combat team. This combat team is comprised of a regiment of infantry with supporting field artillery. The remainder of the Medical Battalion is made up of a Headquarters Company, and a Clearing Company.

Each Collecting Company is further divided into a Litter-bearer Section, an Ambulance Section and a Station Platoon. The Litter Bearer Section evacuates casualties from the Battalion Aid Station to the Collecting Station, located about fifteen hundred yards to one mile in the rear. This station is set up by the Station Platoon. The Ambulance Clearing Station evacuates casualties to the Clearing Station, located six to ten miles in the rear.

PROCEDURE WITH PATIENTS

On entering the Collecting Station, the casualty is admitted to the receiving and sorting department and from there the walking wounded are transferred to one side of the station for treatment, while the litter wounded are cared for on the other side. As the casualties pass on through the Collecting Station, the records of patients from both sides of the station are taken by a central unit. If necessary, a gas section is set up. The patients are cleared through the rear of the Collecting Station on to the Clearing Station by means of the Ambulance Section.

Upon the evacuee's arrival at the Clearing Station the same system of evacuation to the rear continues. The Clearing Station consists of a Supply Section, Administration Section, a section for caring for the shocked patient, and a

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separate section for the walking wounded. Evacuation of the casualties from this station to the rear is taken care of by the rear echelons.

The nearest surgical facility to be encountered in the vicinity of the Clearing Station is the Mobile Surgical Hospital. However, more recent developments in the Army are the Trailer and Bus Operating Rooms produced at the experimental laboratory at Carlisle Barracks Medical Field Service School. This provides a sanitary, perfectly equipped operating room, seven and one-half by eleven feet. There is working space for an anesthetist, a surgical team of three operators and a surgical nurse. It carries enough supplies to perform twenty-four operations in a twenty-four hour period. This trailer operating room is accompanied by a sterilizer, power plant, a trailer kitchen, bedside x-ray and a supply truck. The trailer operating rooms are used in conjunction with a tent hospital, and all can be brought very close to the front lines. All transportable wounded are sent to this unit, operated, and put to bed in the tent hospital. When the battle casualties have been operated and otherwise cared for, the trailer operating room, power plant and other units can be moved to other areas where they are needed.

This trailer operating room is vastly superior to the Mobile Surgical Hospital used in the World War I, which required forty trucks of one and one-half tons each for transportation, and eleven trucks for personnel. In many instances, one or more trucks would fail to arrive, and thus render the hospital useless. When this hospital was set up and filled with patients it became immobile, and was of no further use until the patients could be evacuated.

As to the surgical functions of each of these links in the chain of evacuation, it is evident that definitive surgical care of battle casualties increases directly with the evacuation toward the rear.

First Aid Treatment is administered by the Company or Battery Aid men, who are the first ones to contact the battle casualty. What the Company Aid Man is able to do or not to do, in many instances, determines whether or not the casualty survives. His duty is to check severe hemorrhage, render first aid, and direct walking wounded toward the Battalion Aid Station. The casualty is then evacuated to the Battalion Aid Station by the Litter-bearers, who form a portion of the advanced Regimental Medical Detachment.

At the *Battalion Aid Station*, very limited surgical treatment is available, and the function of this station is to render only such emergency treatment as may be necessary to return the casualty back to the front as an effective or to prepare him for further evacuation to the Collecting Station. The Battalion Aid Station is equipped with a limited supply of ether and ethyl chloride, and with some procaine and epinephrine tablets for preparing a solution for local anesthesia. It is, in addition, amply supplied with morphine sulphate. These drugs are a part of the

equipment supplied in the No. 2 Medical Chest.

In connection with surgical care at the Battalion Aid Station, it is emphasized that primary shock can be precipitated by pain. Therefore, the importance of controlling pain at the earliest possible opportunity cannot be over-emphasized. With the facilities available at this forward station, pain can be controlled with morphine or, in some cases, by the use of ether or ethyl chloride singly or in combination as inhalation anesthetics. The use of regional anesthesia on a severely traumatized extremity for transportation of the casualty to the rear, is still an idea yet to be attained. The amount of local anesthesia available at the forward stations is too limited for any such extensive use.

At the *Collecting Station*, where the Medical Battalion begins to take over the Divisional medical service, the provisions for anesthesia are increased by the addition of another No. 2 Medical Chest, and while the facilities for anesthesia at this station, at best, are quite limited, they are still improved over those available in the Battalion Aid Station. Primarily, the function of the Collecting Station is that of a way station only, and casualties are moved on from there as rapidly as possible. Only such treatment of shock and readjustment of splints and dressings as may be necessary for further evacuation is done here.

It is at the *Clearing Station* that one begins to meet the first definitive surgical treatment. Here the equipment is supplemented by the addition of two more No. 2 medical Chests, and some limited surgery can be done. The most practical anesthesia at the Clearing Station is drop ether, local infiltration and intravenous agents, when the latter can be procured. At the present time there are many experienced anesthetists and I believe at least one could be used at the Clearing Station and, with trained technicians, would find ether, local infiltration and possibly intravenous methods entirely satisfactory. Spinal anesthesia is impracticable here, due to the temporary nature of the hospital. Beds cannot be immobilized, and it is not considered good practice to transport a patient for a period of twenty-four to thirty-six hours after spinal anesthesia. Nitrous oxide and oxygen are impractical at this station because of the difficulty of transporting gas machines and supplying gas cylinders.

The Clearing Station may keep casualties as long as two days or more before evacuating them if it is felt that it might be possible to return them as effectives to their organizations. The Clearing Station evacuates to the Evacuation Hospital such casualties as are not able to be returned to the front. This unit may be located almost any reasonable distance behind the Clearing Station.

In the equipment of the *Trailer* operating rooms, it has been necessary to limit the anesthetic agents to those requiring little space, and ether was the choice of the inhalants. All the spinal anesthetics, the intravenous anesthetics and the local block type of procaine are included.

The treatment at the *Evacuation Hospital* is

usually very complete, and in many instances, practically that of a General Hospital. At most Evacuation Hospitals, it is possible to supplement the anesthetics with pentothal sodium, and spinal, as well as gas-oxygen. Such casualties as require extensive surgery, or wherein the Evacuation Hospital must evacuate them because of overcrowded conditions are sent on to the General Hospital, where the anesthetic resources are practically unlimited.

PROBLEM OF ADEQUATE ANESTHESIA

The problem of producing adequate anesthesia is of necessity more complex under war conditions than it is in peacetime when well-equipped, modern Civilian hospitals are available. The time devoted to each patient must be considered because there may be unlimited numbers of wounded awaiting treatment. The conserving of time does not preclude adhering to the elementary principles of safe anesthetic practice.

From the time a casualty is picked up by the Medical Detachment, his treatment is handled with the aim of preventing shock and evacuating him to the rear for definitive treatment in the best possible condition. This condition must be evaluated by the anesthetist and the anesthetic agents and method of administration should contribute a minimal amount toward the shock already present, or, if possible, reduce it. Due to the wide scope of activity and the varied climatic conditions under which we expect to operate in this war, the most satisfactory agent on one front may be useless on another.

SOME BASIC PRINCIPLES

A few basic principles can be observed under all conditions. We know that pain is one of the causes of primary shock and that fluid loss is present in all cases of secondary shock. Some important functions of the blood are:

1. Transportation of oxygen by the red blood cells.
2. Maintenance of coagulation qualities by fibrinogen and prothrombin.
3. Maintenance of osmotic pressure and the furnishing of nutrition by the plasma proteins.
4. Aid in fighting infections by antibodies and phagocytosis.

These functions are interfered with in the presence of severe pain with a resultant lowering of blood pressure, or in the presence of marked fluid loss. If an anesthetic which diminishes the supply of oxygen is administered under these conditions the degree of shock manifest is accentuated immediately. Prior to starting any anesthetic, an attempt should be made to relieve the pain with narcotics and to replace the fluid loss by administering whole blood or blood plasma. Intravenous glucose and saline will produce a temporary rise in blood pressure and allow the red blood cells present to function more efficiently. This beneficial effect is fleeting and any operation requiring deep anesthesia should be delayed until a

more permanent means of maintaining the blood pressure is established. The patient in severe shock should have sufficient plasma and whole blood to practically replace the amount lost. This may require from five hundred to two thousand cubic centimeters or more, depending on the degree of shock present.

After adequate treatment for pain and shock, the patient's stomach should be emptied before starting the anesthetic, provided the injury was sustained within an hour or so after eating. Theoretically an ample supply of anesthetic agents and equipment should be available from the mobile hospital or trailer operating units to the General Hospital. Actually this will not always be true during an active campaign.

The disadvantages of spinal anesthesia on shocked patients more than offset its advantages.

Injuries to the lower extremities would be improved if the patient were given a spinal anesthetic which affected only the lumbar segments. If the anesthesia should extend higher to the thoracic region, producing a marked drop in blood pressure and an intercostal paralysis, the degree of shock would be increased. High spinal anesthesia frequently produces as much as fifty per cent decrease in the tidal air exchange. Such a decrease in the presence of a poorly functioning circulatory system could be fatal. Unfortunately we cannot always be certain that a spinal anesthetic will not extend higher than is desirable. When it is necessary to operate on a patient in shock, some type of regional field block, combined with inhalations of oxygen, or supplemented with gas and oxygen, or pentothal and oxygen to produce additional analgesia is the safest procedure.

Intravenous anesthesia with pentothal sodium or evipal soluble offers a pleasant, rapid induction of anesthesia. Under civilian conditions, where the patient can be premedicated adequately, and where oxygen is available at all times, their use is perfectly safe by one who is adequately trained.

Soldiers in the fighting line are young and robust. Under the stress and strain of war conditions they are keyed up to a high pitch which may be due to excitement, anger or fear. Under such conditions an ordinary dose of morphine may show little effect. Pentothal sodium or evipal soluble administered in these cases frequently requires an excessive dose to produce unconsciousness. Two grams of pentothal, within ten minutes, has been given to such patients without producing sufficient anesthesia to suture a laceration on the leg. When an excessive dose has been used these cases sleep for a long time and need to be watched very carefully to prevent the airway from becoming obstructed. These drawbacks offset the advantages of intravenous anesthesia except in permanent installations where oxygen and adequate nursing facilities are available. In the Evacuation Hospital and the General Hospital their use, combined with regional or spinal, or combined with gas-oxygen mixtures, will be the same as in civilian practice.

During the last World War, a member of the French Army, Colonel DePage, used a mixture of twenty-four cubic centimeters of ether, five and one half cubic centimeters of ethyl chloride, and one half cubic centimeter of chloroform. This mixture was placed on a gauze-covered cotton pad in a hood made of rubber sheeting. This hood containing the gauze pad saturated with three quarters of an ounce of the above mixture for small or debilitated cases and one and one quarter ounces for large husky individuals, was placed over patient's face and held up in the center to allow room in which to breathe. The theory of this mixture was that the ethyl chloride would evaporate first and produce a rapid loss of consciousness. The chloroform would tide over between the ethyl chloride and ether. By this method induction required approximately two minutes and the anesthesia would last about eight minutes. If the operation was to take longer than eight to ten minutes, the anesthetic was continued under open drop ether. Dr. Guedel used this method in several thousand cases with satisfactory results. Vinyl ether should prove of value used in a similar manner or to replace the ethyl chloride in the above mixture. This same procedure will undoubtedly prove useful in the present war for those cases not in severe shock and for short procedures where a gas machine and oxygen are not available.

IN CONCLUSION

In conclusion I should like to emphasize the importance of adherence to recognized standards of anesthesia;

1. Relieve pain and primary shock with narcotics.
2. Treat the shock present with adequate blood or blood plasma.
3. Empty the stomach of undigested food, if injury has occurred shortly after eating.
4. Use an anesthetic agent and method that will contribute a minimal amount toward shock or preferably aid in reducing it.
5. Maintain a free airway with adequate air or oxygen at all times.

The facilities for anesthesia are extremely limited. However conditions forward do not permit the use of anesthetics to any degree, even if they were available, since the function of the forward portions of the Medical Service with the Division is the evacuation of battle casualties as rapidly as is consistent and practical with the safe transportation of the casualty.

From the Clearing Station on to the General Hospital the availability of anesthetic agents and equipment is quite complete, and trained anesthesiologists will have the same opportunity for exercising their skill and judgment under military conditions as they had in civilian practice.

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DEHYDRATED FOOD IN WAR AND PEACE*

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IN discussing the subject of dehydrated foods, their importance in the present war, and their probable importance in the peace that follows, there is no intention of giving the impression that the dehydration of food is a new industry. On the contrary, as you well know, the practice of drying food is centuries old. However, the dehydrated food industry is being revamped to suit modern standards. Our present knowledge of vitamins is sufficient reason for seeking to improve dehydration processes so as to permit maximum retention of these labile elements.

The *Journal of the American Medical Association* for September 12, 1942, contains an article on the "Nutritional Aspects of Feeding an Army," by Colonel Paul E. Howe¹ and in the same issue Captain Ernest W. Brown has discussed the "Nutritional Aspects of Feeding in the United States Navy".² Both authors stress the important rôle played by food and its preparation in the maintenance of morale. An adequate diet and its proper preparation aids the maintenance of morale by means other than merely satisfying the appetite in a pleasing manner. An adequate diet implies the proper amounts of the various vitamins, and present knowledge of the mechanism of action of the vitamins provides a real physiological basis for the preservation of morale.

As pointed out by Captain Brown,² recognition of the importance of vitamins together with the space limitation in a submarine gives rise to a special dietary problem in this branch of the Navy under war conditions. "These vessels are assigned to patrols which may extend sixty days or over. The storage capacity for provisions is so limited that the protective foods, in the form of fresh fruits and vegetables, eggs and milk, can be carried for only relatively short periods, the personnel then subsisting chiefly on meat and preserved foods, largely of the canned type. There appears to be no doubt as to the adequacy of the caloric and protein aspects of the ration, but there is some question with respect to the sufficiency of vitamin and mineral constituents. The possibility has not been put to the test of a nutrition survey, but all submarine personnel are now supplied with a vitamin complex as a means of forestalling any potential deficiency in these items."

GROWING RECOGNITION OF IMPORTANCE OF VITAMINS

This growing recognition of the importance of vitamins in an adequate diet makes it imperative that we produce a higher quality of dehydrated vegetables than was supplied to the armed forces

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